EGGS OF SOME TASMANIAN NOCTUIDAE (LEPIDOPTERA)

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Abstract

Morphological and biological data are presented for the eggs and oviposition behaviour of *Rictonis atra* (Guenée), *R. cyanoloma* (Lower), *R. microspila* (Lower), *R. ophiosema* (Turner), *R. tortisigna* (Walker), several undetermined *Rictonis* species, *Diarsia intermixta* (Guenée), *Peripyra sanguinipuncta* (Guenée), *Neumichtis sepultrix* (Guenée), *N. archephanes* Turner, *N. saliaris* (Guenée) and *Syntheta nigerrima* (Guenée).

Introduction

Since the revisions of the Tasmanian Lepidoptera by Turner (1925, 1938) very little has been recorded of the Tasmanian Noctuidae. The eggs of *Rictonis* Nye, *Neumichtis archephanes* Turner, *N. saliaris* (Guenée) and several minor pest species are discussed below as part of an ongoing study of the Tasmanian Noctuidae, particularly of the immature stages.

Rictonis is an objective replacement name for *Nitocris* Guenée (Nye, 1975) and is the largest noctuid genus in Tasmania. It is represented by around 20 species though none are of economic importance. Original descriptions of these species are inadequate and it is presently difficult to identify many species found in Tasmania. The male genitalia possess elongate tapering valvae bearing a single row of spines in the distal fifth and, with the claspers and aedeagus, provide no simple characters for specific differentiation. Exceptions are *R. leucosticta* (Turner) and *R.* sp. near *flexirena* (Walker) in which valva spines are absent. The larvae provide some useful specific characters including cuticle spicule size, head and body markings, and crochet formulae (Hill, unpub. thesis).

Methods

275 female Noctuidae representing 45 species were collected at a blended MV light and confined to glass jars covered with stretched muslin. Creased paper towel and greaseproof paper were added to provide four potential oviposition substrates viz. paper towel, greaseproof paper, glass walls and floor, and muslin. A potential fifth substrate in each jar was a small plastic vial containing a 2% sugar solution and paper wick.

Females were maintained at 18-22°C in an optionally heated laboratory exposed to natural light (February-March) plus an irregular amount of artificial light on many nights. In the same room all eggs were maintained on moist filter paper in petri dishes. Eggs were not surface sterilized and good hatching rates were obtained except for the eggs of hadenine species.

Because precapture oviposition histories of females were not known, data for fecundity and longevity of each species are presented as maxima observed as well as averages.

Eggs were measured in 80% ethanol plus 5% glycerol using a dissecting microscope and scaled eyepiece at x40. Diameters were measured and vertical ridges counted in dorsal view at the equator while heights of domed eggs were measured in lateral view from the micropyle to the circumference of the smooth base. Averages of vertical ridge numbers have been rounded to whole numbers. General observations of preserved eggs were made at x80. Fragments of chorion from preserved eggs were mounted in lactophenol on slides and measurements of aeropyle vestibules and ribbing made with a scaled eyepiece at x400. Scanning electron micrographs were obtained from a JEOL JXA 50A microscope using live eggs mounted to brass stubs and coated with a thin layer of gold over carbon in a JEOL JEE 4B vacuum evaporator.

The terminology of Salkeld (1973, 1975) is applied to the chorionic architecture but the term ribbing rather than reticulation is used to refer to well defined struts lying on the chorion surface, often along ridges of the chorion.

Material examined

Eggs obtained from the following specimens were examined along with slide preparations of chorion fragments from those asterisked. The numbers given are the author's unique specimen numbers attached to specimens. Unless otherwise stated specimens are deposited in the Tasmanian Agriculture Department Entomology Branch collection. Other depositories are ANIC Australian National Insect Collection and LH author's collection. All specimens were collected in southern Tasmania in 1979 and 1980. Eggs from specimens in bold type are deposited in ANIC. *Rictonis atra* (Guenée) **633*** LH; *R.* sp. near *capularis* (Guenée) 635* LH, 636 LH; *R.* sp. near *cryphaea* (Turner) 61*; *R. cyanoloma* (Lower) 272, 273, 274*, 276; *R.* sp. near *flexirena* 36*, **650** LH, 651* LH; *R. microspila* (Lower) 18, 22, 29, 30, 39*, 66, 231, 257, 258, 293; *R. ophiosema* (Turner) 228, 229*, 305, 369, 429, 630 LH, 637 LH, 638 LH; *R. tortisigna* (Walker) 108, 259, 260, 308*; *R.* sp. 1 277*; *R.* sp. 3 168*, 171, 174, 175, 307, 311; *R.* sp. 7 278*; *R.* sp. 8 309*; *R.* sp. 9 64*; *Peripyra sanguinipuncta* (Guenée) 20, 26, 27, 28, 50, 51*; *Diarsia intermixta* (Guenée) 23, 63, 163, 296, 299, 385, 510, 511*; *Syntheta nigerrima* (Guenée) 4, **582*** ANIC; *Neumichtis sepultrix* (Guenée) 295, 297*; *N. saliaris* 16*, **492*** ANIC; *N. archephanes* 1, 2, 3, 5* ANIC, 6.

Adult specimens reared from eggs of some of the preceding moths are deposited in the ANIC as follows: *R. atra* 1 ♀ ex 633; *R.* sp. near *capularis* 1 ♂ ex 635, 1 ♂ ex 636; *R.* sp. near *cryphaea* 1 ♀ ex 61; *R. cyanoloma* 1 ♂ ex 272; *R. microspila* 1 ♀ ex 39, 1 ♀ ex 258; *R. ophiosema* 1 ♂ ex 305, 1 ♀, 1 ♂ ex 369; *R. tortisigna* 1 ♂ ex 260; *R.* sp. 3 1 ♂ ex 175; *N. sepultrix* 1 ♂ ex 297.

Results

Rictonis Nye (Figs 1-9)

Description of egg.– Domed; chorion with vertical ridges extending from outer margins of tertiary cells to circumference of large smooth flat base; vertical ridges bearing narrow longitudinal ribs 2-4 μm wide; horizontal ribs lying 20-30 μm apart linking vertical ribs, usually narrower than latter, their junctions with vertical ribs alternating along either side of latter; aeropyle vestibules 2-4 μm diameter, at junctions of vertical and horizontal ribs, extending entire length of vertical ridges; vertical ridges widening or not at aeropyle loci (e.g. *R. microspila* vertical ribs 2 μm wide, aeropyle vestibules 4 μm diameter, ribs widening conspicuously to 7 μm around aeropyle loci; *R. tortisigna* vertical ribs 2 μm wide, aeropyle vestibules 2 μm diameter, ribs barely widening around aeropyle loci; *R. cyanoloma* vertical ribs 2 μm wide, aeropyle vestibules 1 μm diameter, ribs not widening at aeropyle loci); columnar cell chorion varying from smooth (*R. microspila* and *R. tortisigna*) to gently reticulated (*R. ophiosema*) at x1000 in scanning electron micrographs and appearing solid or very finely ringed in slide preparations at x400; micropylar rosette above level of secondary and tertiary cells, at same level as dorsal ends (shoulders) of vertical ridges. *R.* sp. near *flexirena* differing from the preceding as follows: columnar cell chorion granular; vertical ribs 5 μm wide; aeropyle vestibules 3 μm diameter; vertical ribs not widening at aeropyle loci. Table 1 lists vertical ridge number, height, diameter and colour sequence during incubation for eggs of 13 species.

TABLE 1

Rictonis egg dimensions and colour sequence through incubation; N–number of females providing eggs, n–number of eggs measured (sample sizes for vertical ridge counts are usually larger), c–cream, g–grey, r–red, p/c–pink dorsally and cream ventrally.

Species	Vertical ridges ave (range)	Height mm ave (range)	Diameter mm ave (range)	Colour sequence	N	n
R. atra	37 (33-40)	0.45 (0.43-0.47)	0.66 (0.65-0.67)	c, g	1	10
R. nr. *capularis*	38 (34-40)	0.56 (0.54-0.57)	0.66 (0.64-0.68)	c, g	2	20
R. nr. *cryphaea*	36 (34-39)	0.48 (0.45-0.50)	0.63 (0.62-0.64)	c, g	1	10
R. cyanoloma	48 (45-54)	0.68 (0.63-0.76)	0.87 (0.80-0.95)	c, g	4	40
R. nr. *flexirena*	26 (23-33)	0.46 (0.39-0.50)	0.68 (0.66-0.73)	c, p/c, g	3	25
R. microspila	39 (33-43)	0.49 (0.42-0.59)	0.63 (0.56-0.71)	c, g	11	102
R. ophiosema	25 (21-29)	0.43 (0.38-0.49)	0.63 (0.57-0.69)	c, r, g	9	89
R. tortisigna	30 (26-33)	0.43 (0.41-0.48)	0.59 (0.55-0.63)	c, g	4	40
R. sp. 1	34 (31-36)	0.41 (0.39-0.42)	0.56 (0.55-0.56)	c, g	1	10
R. sp. 3	31 (25-37)	0.45 (0.41-0.50)	0.64 (0.57-0.73)	c, r, g	6	58
R. sp. 7	27 (24-29)	0.49 (0.46-0.50)	0.72 (0.69-0.74)	?c, r, g	1	10
R. sp. 8	36 (35-38)	0.47 (0.43-0.49)	0.63 (0.57-0.63)	c, g	1	10
R. sp. 9	34 (33-36)	0.51 (0.45-0.55)	0.62 (0.62-0.63)	c, g	1	3

TABLE 2

Egg incubation durations and fecundity and longevity of females at 18-22°C.

Species	Incubation (days)	Number of eggs laid max.	Number of eggs laid ave	Longevity (days) max.	Longevity (days) ave	N
R. atra	12-14	–	–	–	–	1
R. nr. *capularis*	12-19	–	–	–	–	2
R. nr. *cryphaea*	8-18	375	–	7	–	1
R. cyanoloma	9-15	74	48	8	7	5
R. nr. *flexirena*	5-14	118	104	16	11	3
R. microspila	23-48	211	121	31	15	10
R. ophiosema	10-24	359	115	21	9	7
R. tortisigna	11-17	315	144	8	6	4
Rictonis sp. 1	14-21	106	–	12	–	1
Rictonis sp. 3	7-23	307	93	12	7	8
Rictonis sp. 7	9-18	343	–	8	–	1
Rictonis sp. 8	8-25	128	–	8	–	1
Rictonis sp. 9	9-11	40	–	4	–	1
D. intermixta	4-12	739	441	24	19	8
S. nigerrima	4-8	369	219	19	11	3
N. sepultrix	6-12	605	313	19	12	3
N. saliaris	–	100	80	11	9	2
N. archephanes	7-10	304	221	8	8	3
P. sanguinipuncta	4-15	714	307	32	16	10
P. ewingii	7-10	1304	400	15	9	6
*P. ewingii**	ave 8	?	500	?	10	50

* Data from Pickett (1979).

Oviposition.– All 13 species (Table 1) examined cemented eggs by the base to a substrate and in 11 species eggs were placed singly or in occasional groups of 2-5 eggs. These 11 species oviposited with greatest frequency on the muslin jar covers. Chi squared tests based on substrate areas comparing the deviations of observed oviposition frequencies on 5 substrates with those expected from random oviposition were significant in the preceding cases. The remaining 2 species, *R.* sp. near *cryphaea* and *R.* sp. 9, placed eggs in single layered clusters of around 50 eggs on the glass jar walls. Fecundity (see Table 2) was relatively low.

Incubation.– Incubation periods (see Table 2) of some species were moderately long and, in *R. microspila* in particular, covered a wide range for eggs from any one female.

Diarsia intermixta (Guenée) (Figs 13-16)

Description of egg.– As for *Rictonis* but: vertical ribs 2.5 μm wide; horizontal ribs 2.0 μm wide; aeropyle vestibules 2.0 μm diameter; horizontal ribs lying *ca* 25 μm apart; vertical ribs barely widening at aeropyle loci; micropylar rosette *ca* 70 μm diameter, with *ca* 9 cells; height 0.46 mm, range 0.39-0.50 mm, diameter 0.64 mm, range 0.59-0.70 mm, n = 77 eggs from 8 females; vertical ridges 35, range 28-38, n = 180 eggs from 8 females; colour cream when laid.

Oviposition and incubation.– *D. intermixta* placed eggs in single layered clusters of around 50 eggs, each egg being cemented by the base and with space between it and neighbouring eggs. The incubation period was short (Table 2).

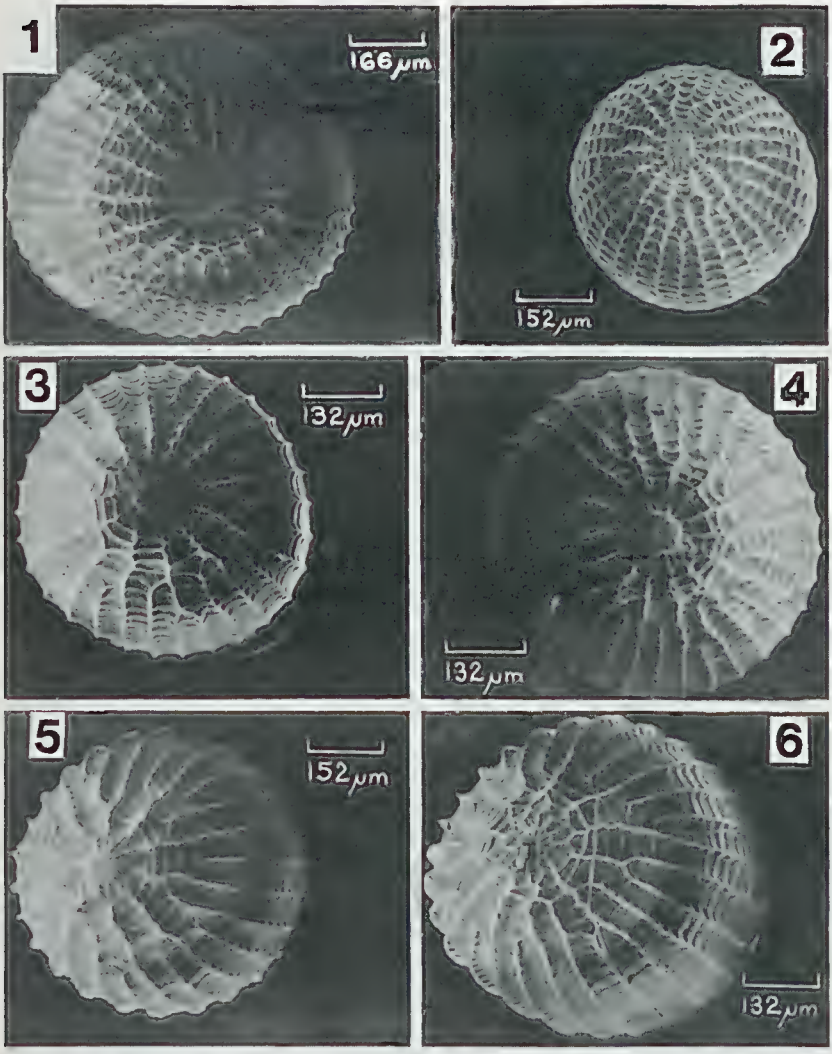
Peripyra sanguinipuncta (Guenée)

Description of egg.– Subspherical; chorion with vertical ridges extending from outer margins of tertiary cells to near ventral pole; no smooth base; vertical ridges bearing straight longitudinal ribs, 8 μm high, 3 μm wide; faint horizontal ridges without ribs, lying *ca* 20 μm apart, linking vertical ridges, their junctions with vertical ridges alternating along either side of latter, chorion smoother than columnar cell chorion; aeropyle vestibules 2 μm diameter, on vertical ridges at junctions with horizontal ridges, extending entire length of vertical ridges; vertical ridges not widening at aeropyle loci; columnar cell chorion bearing numerous granules 1-2 μm diameter; micropylar rosette *ca* 60 μm diameter, with *ca* 13 cells, at same level as dorsal shoulders of vertical ridges; height 0.60 mm, range 0.56-0.66 mm, diameter 0.62 mm, range 0.56-0.66 mm, n = 56 eggs from 6 females; vertical ridges 26, range 22-29, n = 217 eggs from 6 females; colour cream when laid.

Oviposition and incubation.– *P. sanguinipuncta* did not cement its eggs to any substrate but scattered them loosely on the floor of the oviposition jar. Fecundity was moderately high and incubation duration was short (Table 2).

Syntheta nigerrima (Guenée) (Figs 18, 20)

Description of egg.– Domed; chorion with vertical ridges extending from outer margins of tertiary cells to circumference of large smooth flat base;



Figs 1-6. Scanning electron micrographs of *Rictonis* eggs: (1) *cyanoloma*; (2) species 1; (3) *tortisigna*; (4) *microspila*; (5) species 7; (6) species 3.

vertical ridges without ribs; horizontal ridges similar but narrower, lying *ca* 35 µm apart, junctions with vertical ridges alternating along either side of latter; aeropyle vestibules 5 µm diameter, at junctions of vertical and horizontal ridges, extending entire length of vertical ridges; vertical ridges not widening at aeropyle loci; columnar cell chorion deeply pitted, appearing

densely pitted by holes *ca* 1 μm diameter in slide preparations at x400; chorion of vertical ridge-caps not deeply pitted, *ca* 9 μm wide; chorion of horizontal ridges not clearly differentiated from pitted columnar cell chorion; micropylar rosette *ca* 55 μm diameter, with *ca* 9 cells, above level of secondary and tertiary cells, at same level as dorsal shoulders of vertical ridges; height 0.43 mm, range 0.36-0.48 mm, diameter 0.65 mm, range 0.60-0.70 mm, n = 20 eggs from 2 females; vertical ridges 20, range 18-21, n = 50 eggs from 2 females; colour cream when laid.

Oviposition and incubation.– *S. nigerrima* placed eggs singly and occasionally in small groups, each egg being cemented by the base to a substrate. Incubation duration was short and fecundity relatively low (Table 2).

Neumichtis sepultrix (Guenée) (Fig. 12)

Description of egg.– As for *S. nigerrima* but; horizontal ridges *ca* 30 μm apart; aeropyle vestibules 3 μm diameter; micropylar rosette *ca* 60 μm diameter; height 0.43 mm, range 0.41-0.48 mm, diameter 0.71 mm, range 0.66-0.76 mm, n = 20 eggs from 2 females; vertical ridges 29, range 26-31, n = 45 eggs from 2 females.

Oviposition and incubation.– Oviposition was as for *S. nigerrima.* Incubation duration was short and fecundity moderately high.

N. saliaris (Guenée) (Figs 17, 19)

Description of egg.– As for *S. nigerrima* but; horizontal ridges *ca* 6 μm wide, *ca* 40 μm apart; aeropyle vestibules 6 μm diameter; chorion of horizontal ridges distinctly smoother than pitted columnar cell chorion; micropylar rosette *ca* 60 μm diameter; height 0.46 mm, range 0.38-0.53 mm, diameter 0.68 mm, range 0.64-0.74 mm, n = 18 eggs from 2 females; vertical ridges 19, range 17-20, n = 28 eggs from 2 females.

Oviposition and incubation.– Oviposition was as for *S. nigerrima.* Incubation duration is unknown and fecundity was relatively low.

N. archephanes Turner

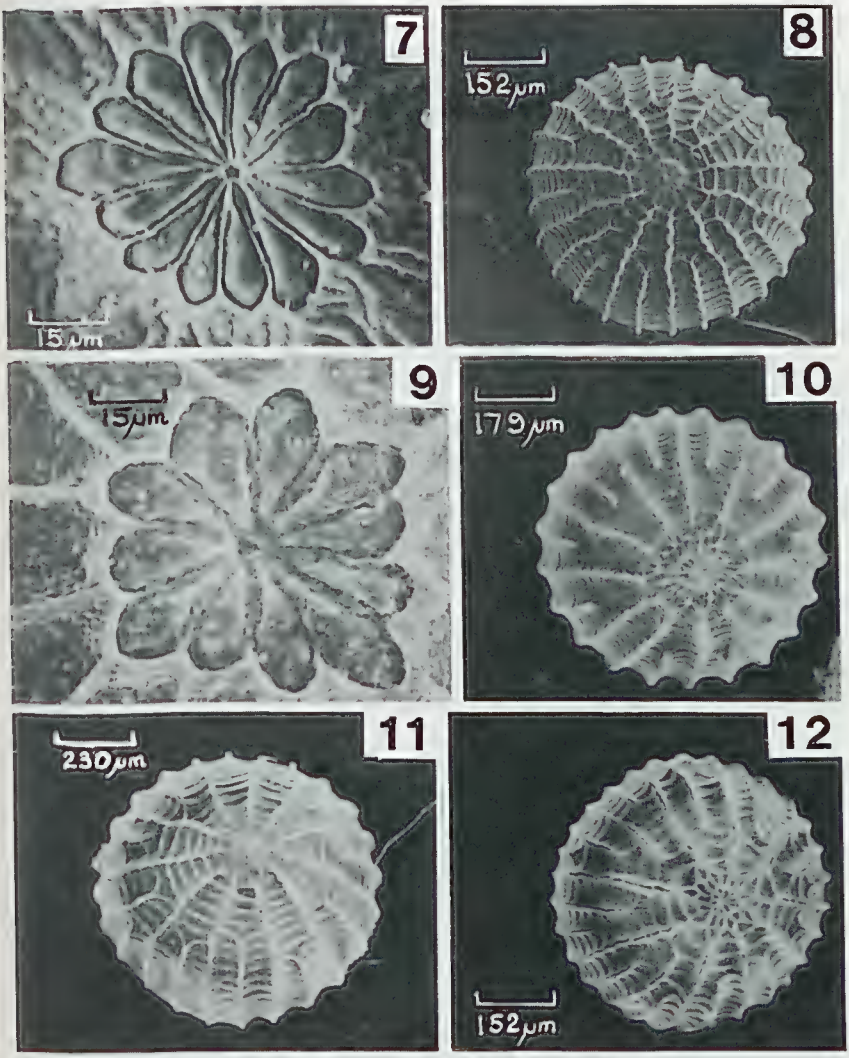
Description of egg.– As for *S. nigerrima* but; horizontal ridges *ca* 6 μm wide, *ca* 30 μm apart; aeropyle vestibules 3 μm diameter; columnar cell chorion deeply pitted near base, coarsely reticulated elsewhere; chorion of horizontal ridges distinctly smoother than columnar cell chorion; micropylar rosette *ca* 65 μm diameter; height 0.55 mm, range 0.49-0.59 mm, diameter 0.90 mm, range 0.80-0.97 mm, n = 43 eggs from 5 females; vertical ridges 19, range 16-22, n = 81 eggs from 5 females.

Oviposition and incubation.– Oviposition was as for *S. nigerrima.* Incubation duration was short and fecundity relatively low.

Comments

Egg form

Among the Tasmanian Noctuidae eggs of a domed and vertically ridged form are most common. The genera *Neumichtis, Euplexia, Rictonis*



Figs 7-12. Scanning electron micrographs of eggs: (7) *R. ophiosema*, micropylar area; (8) *R. ophiosema*; (9) *R.* sp. near *flexirena*, micropylar area; (10) ?*Euplexia* sp.; (11) ?*Euplexia* sp.; (12) *N. sepultrix*.

and the species *D. intermixta*, *Agrotis porphyricollis* (Guenée), *Corrha difficilis* Walker and *Praxis edwardsi* Guenée have eggs of a domed form with height equal to approximately three-quarters of the diameter, a large smooth flat base and pronounced vertical ridges of variable form. *Rhapsa suscitalis* Walker also possesses a domed egg but it is devoid of chorion

ridging and bears a fine and roughly hexagonal network of ribs with erect tubes bearing aeropyles at the rib junctions. The second most common egg form is the smooth subspherical to oval one found in 13 hadenine species examined. These eggs are usually laid in large groups within a supporting gel and often in crevices. Although bearing vertical ridges and ribs the egg of *P. sanguinipuncta* is subspherical in form. As noted above, eggs of this species are not cemented to any substrate but scattered loosely. They are also not supported within a gel and the well developed ridges and ribs may be associated with this lack of support.

Rictonis species

Rictonis sp. near *flexirena* differs from other species of the genus examined in possessing a granular chorion surface (similar to that of *P. sanguinipuncta*), lacking spines on the male valvae, adult seasonality (spring flying rather than autumn flying), aspects of larval morphology and rate of larval development (2 months larval duration versus 3-5 months). *R. leucosticta* also lacks spines on the male valvae and flies in spring. These two species may form part of a species group distinct from the other *Rictonis* species examined. Unfortunately the eggs and larvae of *R. leucosticta* could not be studied for comparison with *R.* sp. near *flexirena.*

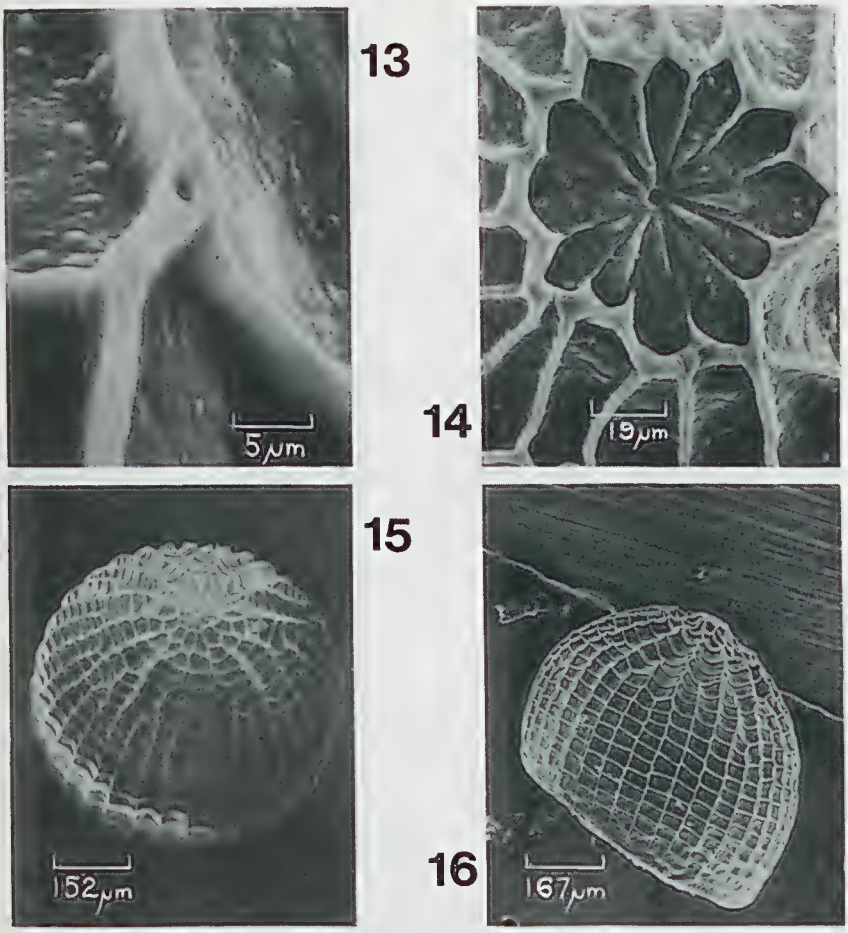
Intraspecific variation

The intraspecific ranges in vertical ridge number given here are much larger than those reported by Peterson (1964) for many American Noctuidae. A sample of 78 eggs from six *Rictonis* sp. 3 females revealed the largest ranges in vertical ridge number and egg diameter encountered during study of 13 species of this genus, viz. average ridge number 31, range 25-37, average standard deviation per female 1.35, standard error 2.89 and average diameter 0.64 mm, range 0:57-0.73 mm, average standard deviation per female 0.02 mm, standard error 0.04 mm. Average vertical ridge number for 8 females of *D. intermixta* was placed strongly towards the upper end of the range viz. average 35, range 28-38. To obtain a good measure of intraspecific ranges in ridge number and egg size it is necessary to examine at least five eggs from each of 5-10 females. These sample sizes are similar to those used by Matheny and Heinrichs (1972) and larger than those of Salkeld (1975).

The standard deviation per female for egg height and diameter was *ca* 0.02 mm for all species whose eggs are described above. Heights of live eggs of *Euplexia iorrhoa* (Meyrick) were found to be as much as 15% greater than those of ethanol preserved eggs. This reduction of height by preservation probably applies to all other domed, vertically ridges eggs because these eggs become more globular upon ethanol preservation such that the height is reduced but the diameter is not greatly affected.

Ridging

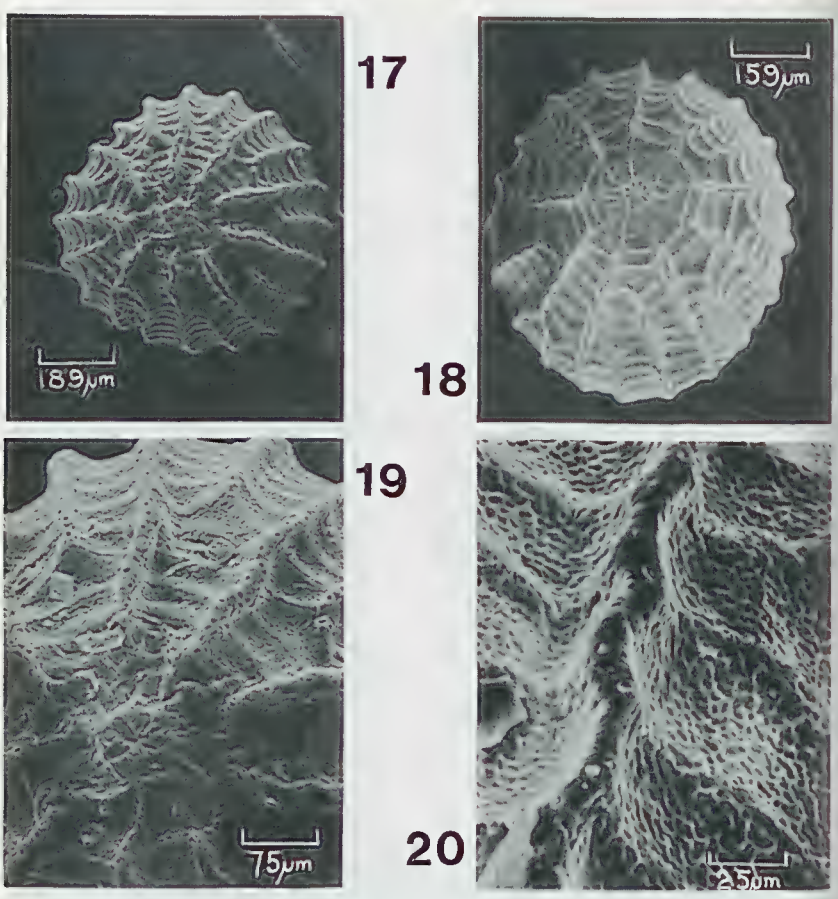
Not all vertical ridges reach dorsally to the outer margins of the tertiary cells because around one half finish before reaching this level. The fine



Figs 13-16. Scanning electron micrographs of *D. intermixta* eggs: (13) vertical rib and horizontal ribs at 2 aeropyle loci; (14) micropylar area; (15) dorsal; (16) lateral.

structure of the chorion cannot be observed using a dissecting microscope at x80 but the difference between vertical ridges bearing longitudinal ribs and those without can be discerned. In dorsal view of the egg the latter type of ridge appears gently rounded and ill-defined while the former type appears sharply defined. In ethanol preserved eggs whose embryos have contracted ribs appear as white lines across the chorion.

In several undetermined species of ?*Euplexia*, the vertical ridges bear very wide (11-17 μm) ribs with large (10-15 μm diameter) aeropyle vestibules (Figs 10, 11). The distance between neighbouring vestibules is less than their diameter so that they appear as a series of contiguous rings along each



Figs 17-20. Scanning electron micrographs of eggs: (17) *N. saliaris*; (18) *S. nigerrima*; (19) *N. saliaris*, dorsal; (20) *S. nigerrima*, vertical ridge.

vertical ridge in ethanol preserved eggs. Such rings cannot be discerned in the species whose eggs are described here when using a dissecting microscope.

Differences in vertical ridge structure similar to those illustrated by Döring (1955) for moth eggs were found within *Rictonis*. The vertical ridges of *R. ophiosema* appear to rise abruptly from a relatively flat columnar cell area while those of *R. microspila* rise and fall continuously around the egg equator viewed dorsally. These two types may correspond respectively to the rechteckige and flackkegelige types of Döring.

Primary cells

The micropylar rosette of primary cells is raised above the secondary and tertiary cells and at the same level as the dorsal ends of the vertical

ridges in *Rictonis, Peripyra, Neumichtis, E. iorrhoa, S. nigerrima* and *A. porphyricollis.* It is not raised above the secondary and tertiary cells in the large (*ca* 1 mm diameter) dark eggs of *P. edwardsi* and *C. difficilis.* Also none of the vertical ridges in these two species, whose eggs are very similar, extend dorsally to the outer margins of the tertiary cells. In *R. suscitalis* the rosette of primary cells is not raised. The elevation of the rosette can be observed with a dissecting microscope.

Ecological comments

D. intermixta, S. nigerrima, N. sepultrix and *P. sanguinipuncta* have been reported as occasional pest species in Tasmania (Hardy *et al.*, 1978). All have brief egg durations and the first three also are capable of rapid larval development given warm conditions (*ca* two months at 16-21°C). *P. sanguinipuncta* larvae appear to be incapable of rapid development, requiring around five months to pass from first instar to pupa at 16-21°C. Except for the relatively low fecundity of *S. nigerrima*, the first three species appear to possess opportunistic adaptations which probably contribute to their occasional pest occurrences. The relatively high fecundity of *P. sanguinipuncta* may counteract egg losses to be expected from its mode of oviposition and allow it to become a pest in neglected pastures. The relatively low fecundities, long larval durations and often long egg durations may restrain *Rictonis* species from pest status. However host plant preferences could be an important restraining factor in this large genus. *N. archephanes* is a montane species, probably univoltine and little is known of its biology.

Acknowledgements

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